A RATIONALE FOR THE

CLASSIFICATION

OF

RIVERS, STREAMS, and LAKES

IN THE YUKON TERRITORY IN

RELATIONSHIP TO THE PLACER MINING GUIDELINES

This paper was prepared by the Department of Fisheries and Oceans for the Interdepartmental Committee on Placer Mining.

25 34

A Rationale for the Classification of Rivers, Streams and Lakes in the Yukon Territory Relationship to the Placer Mining Guidelines

Interdepartmental Committee on Placer Mining

Department of Fisheries & Oceans, 1983

A. INTRODUCTION

The intent of this paper is to explain how classification of rivers and lakes in the Yukon Territory was developed and how the classification system will fit into the matrix of the "A", "B", "C" and "D" streams as outlined in the Placer Mining Guidelines.

In developing the stream classification it is necessary to know a) the species of fish within a stream, b) the habitat associated with a stream and c) the life history of each species of fish.

The Yukon Territory covers some 536,327 sq.km. , and the actual drainage basin of the Yukon River in Canada covers some 328,930 sq. km . The Yukon River is one of the most important salmon producing rivers in North America. Chinook salmon and chum salmon are the only salmon species in significant numbers. In peak years chinook escapements range between 70,000-100,000 pieces and chum salmon, up to 500,000. Limited access to many of the streams has not permitted a complete inventory of the resource. Where resource data is lacking in a system, habitat assessment and similarity to other areas has been used as a basis for classification.

B. PRIORITY PROTECTION DESIGNATION

To allow placer mining operations to take place while ensuring that the fisheries resource in Yukon is protected, a priority protection schedule has been developed. This schedule separates the important commercial, sport or subsistence fish species in Yukon into two groups as outlined below. This classification is in accordance with the habitat management policy of the Department

of Fisheries and Oceans in order to maintain Canada's economically and socially important fisheries resource.

SCHEDULES OF FISH SPECIES

Schedule I

Chum salmon (Oncorhynchus keta)

Chinook salmon (Oncorhynchus tshawytscha)

Coho salmon (Oncorhynchus kisutch)

Sockeye/kokanee (Oncorhynchus nerka)

Rainbow trout (Salmo gairdneri)

Arctic char (Salvelinus alpinus)

Lake trout (Salvelinus namaycush)

Dolly Varden(Salvelinus malma)

Schedule II

Arctic grayling (Thymallus arcticus)

Inconnu (Stenodus leucichthys nelma)

Humpback (Lake) whitefish (Coregonus clupea formis)

Broad whitefish (Coregonus nasus)

Least cisco (Coregonus sardinella)

Arctic cisco (Coregonus autumnalis)

Burbot (Lota lota)

Northern pike (Esox lucius)

Round whitefish (Prosopium cylindraceam)

The distinction between schedules of fish is based on the way in which fish spawn, and their requirements for spawning and egg incubation. Schedule I fish generally dig 10 to 30 cm deep pits or "redds" in the stream gravels to deposit their eggs. These fish then back fill the redd with excavated gravels.

The exception to this rule in the Schedule I category is the Lake trout (Salvelinus namaycush). Lake trout are more of a "broadcast" spawner; i.e., they broadcast their eggs over the gravel stream bottom. These fish do require coarse substrates which enable the eggs to fall into the interstices between the large gravels. Incubation of lake trout eggs is lengthy usually requiring 4 to 5 months (Scott and Crossman 1973), however this period may be longer in colder environments. Consequently, as with other Schedule I species, it is essential to the survival of lake trout eggs that a clean substrate and good subgravel flow be ensured.

Schedule II fish species are "broadcast" spawners; that is their eggs are merely deposited on the surface of the stream bed. No depressions are made nor are the eggs covered up by the spawners. Species such as Arctic grayling also tend to have a much shorter incubation period; i.e., two to three weeks to hatching, depending on water temperatures.

C. LIFE HISTORIES

The stream classification system for placer mining, was developed to ensure habitat requirements and to protect the sensitive life cycle stages of the various species. To illustrate these requirements the life cycles of salmon,

lake trout and arctic grayling are briefly presented in the following sections. It should be noted however that specific stages in the life cycles of these species may vary in terms of timing and duration depending on site specific conditions.

Salmon

All salmon spend part of their life at sea, but the most vulnerable period for salmon is when they return to the rivers and streams to reproduce. All salmon require clean water and gravel to deposit their eggs. If the spawning grounds are badly silted the female salmon, if she doesn't reject it outright, will have difficulty in clearing the gravels to create a suitable redd (or nest). Compaction of gravels due to siltation may cause stress to the spawning female and can result in either the eggs being deposited in the redds at unsuitable depths or the female rejecting the area outright and possibly dying unspawned. Those eggs spawned in less than optimum conditions will generally result in a reduced survival rate. Once the eggs have been successfully deposited it is important that the gravel remain free of sediment during the incubation period and alevin stage to allow for subgravel water flow. Clean water provides oxygen to the eggs and at the same time removes the matabolic waste produced by the developing embryo. Even when the embryo hatches from the eggs into the alevin stage, the subgravel environment must still remain free of silt to ensure passage of water through the gravel to the alevins, who are now respiring through their gills. The alevins remain in the gravel until such time as they have absorbed their yolk sack and developed strength to become free swimmers. Heavy siltation would make it difficult to impossible for the alevins to swim up through the

gravels and in fact they could be trapped and die due to their inability to move the accumulated fine silts.

The process of spawning through to fry emergence from the gravel bed is the most important stage in the salmon's life cycle. As it is, a survival rate of 5% under normal environmental conditions is considered good. Once the salmon reach the fry stage, each of the species undergoes different juvenile rearing patterns. In Yukon, chinook salmon stay in fresh water for up to two years and in some instances three. This time is generally spent in small clean streams under cover of stream banks and log jams, and in lakes and pools during the winter months. The majority of chum salmon migrate immediately to the sea during or after spring breakup. Coho spend one to two years in fresh water, in small streams, and again in lakes and pools during winter months. Sockeye spend two years in fresh water, normally in lake systems.

Juvenile salmon are basically sight feeders, feeding primarily on aquatic insects. They therefore depend on clean, clear water for the rearing stage of their life cycle. High turbidity created by suspended solids would result in stress by impairing their visual feeding capability. Siltation of a streambed also causes aquatic insects to be displaced, or eliminated, from a system, thus removing available food for rearing.

It has become evident that in Yukon the most successful salmon spawning streams are those that have either lakes within their watershed, or have pools that do not freeze to the bottom, and maintain an adequate flow of water during winter months.

In lakes utilized by salmon in Yukon it is important that the "littoral zone" (zone of light penetration that is the primary area of food production), is not adversely affected. As in streams, siltation and turbidity along a lakeshore will likely result in reduction of primary productivity and/or a destruction of the aquatic insects and their habitat. Reduction of the available biomass or food source may result in a lowering of the survival rate of fish.

Lake Trout

Lake trout are broadcast spawners, and will deposit their eggs over large boulders or rubble bottoms. They will spawn both in lakes and in rivers. It is important for the gravels and boulders to be free of silts so that the eggs may fall into gravel interstices where they may incubate safe from predation. Silting of the spawning areas fills the gravel interstices, thus exposing eggs to predatory fish and birds. The incubation period is lengthy generally spanning 4 to 5 months, perhaps longer in the cooler Yukon waters. With lake spawners it is important to note that the most favourable location for lake trout to spawn is in areas of good water circulation such as in the vicinity of stream outflows. These areas provide incubating eggs with fresh clean oxygenated water. Some lake trout may spawn in other areas as well such as those which provide adequate ground water upwelling which provides the necessary conditions; i.e., clean, oxygenated water to the egg and removal of the embryonic wastes.

Lake trout may migrate up to 100 miles from their spawning grounds, so migratory routes must be left open, free of debris and with adequate water depth to permit free passage. They also tend to move freely from one lake to another.

When juvenile lake trout emerge in northern climates, they tend to remain in nearshore waters of lakes for months or even years. Therefore nearshore areas must be kept silt free for rearing.

Maturation of lake trout in the northern climate does not occur until about 9 years of age. This one facet is responsible for low reproduction, and when compounded by environmental degradation and over-fishing these species can easily be eliminated from a system.

Arctic Grayling

Grayling spawn during the spring time when the ice is first breaking up in smaller streams. They migrate from ice covered lakes and from larger rivers to small gravel bottomed tributaries. Grayling are most successful at spawning if they have a substrate that has clean interstices for them to allow the eggs to enter, similar to that of lake trout. The incubation period is much shorter however, about two to three weeks, depending on water temperature and the fry are nourished by their yolk sacks for approximately one week before becoming free swimmers. Young grayling feed mainly on zooplankton and then gradually shift to aquatic insects such as blackflies, mayflies and caddis flies, midges and a variety of other insects as they grow older and larger.

As with the preceding species, they rely on aquatic and terrestrial insects as the principle food source. Clean gravel substrates and adequate terrestrial bank vegetation are therefore important in providing adequate food sources for these fish.

Grayling reach sexual maturity in the northern climates at about 6 - 9 years of age and they have a life span of 11 to 12 years. With their late sexual maturation and short life span after reaching sexual maturity, grayling can be very susceptible to environmental degradation.

D. CLASSIFICATION RATIONALE

The classification system designates portions of streams as "reaches", rather than an entire stream or watershed. The reaches are classified or evaluated on a habitat quality basis, generally, rather than on a population size basis by using the physical characteristics of the terrain in each stram in conjunction with the known presence and life history of each fish species. To do this, the following criteria were used:

1) Current biological knowledge of the area

2) Stream reach habitat type within a system

3) Relationship to know fisheries resources

4) Similarity to other systems with known fisheries resources

5) Stream slope

6) Elevation

7) River or stream width

8) Available food sources

9) Life histories of each species

10) Migratory patterns of each species

11) Habitat overwintering capabilities

12) Length of stream from source to probable fish utilization

13) Continuous or intermittent nature of stream flow

14) Connections from one lake to another

15) Valley shape: "V", "U", and wide flat-bottomed

16) Association to known marshes, bogs and beaver dams

17) Known barriers such as waterfalls

18) Potential for enhancement

Salmon and other Schedule I fish habitat have been given an "A" or "B" classification; "A" for spawning and "B" for rearing. Where salmon spawning

has been identified in mainstem systems and streams, their tributaries that are within the valley floor have also been classified as potential spawning area. These areas do not have any noticeable slope change and do not present a barrier to upstream migration. Major tributaries with no noticeable slope change have also been given a spawning designation. It should be noted that although there are major salmon spawning streams such as the Nisutlin, Big Salmon, and Yukon River, the numerous small streams with smaller spawning populations contribute significantly to the overall salmon populations. While environmental damage to these small streams may not seem individually significant, these effects are cumulative. It is important to protect these smaller streams in a manner similar to those larger more concentrated streams.

It is very difficult to determine where the cut-off comes between spawning and rearing areas for salmon. In many areas they overalp and often rearing will extend upstream and downstream of spawning areas as well as moving into adjacent tributaries. Depending on the slope of tributaries, rearing areas have been designated within the first 150 to 300 metres in elevation above the main stem. Where braided channels or small ponds or lakes exist for juvenile salmon to migrate to, streams flowing out of these areas have been designated as rearing areas. Salmon fry will use the streams during the summer months and migrate into the lakes and ponds during the winter when the streams dry up or freeze.

On mainstem rivers, particularly those with normally high silt loads, all streams that flow into these rivers and which provide an area of fresh water influence have been classified as Schedule I rearing areas unless spawning has also been indicated. Similar criteria have been used for other

Schedule I species with similar habitat requirements.

Lake trout habitat has also been assigned an "A" designation. Lakes supporting lake trout and the stream leading to and from these lakes fall under this classification. Consideration has been given to stream slope in these cases and in many cases it is only the lower 100 meters of a stream that has been classified "A" due to steep valley sides. Streams connecting lakes which are known to support lake trout have received an "A" classification.

Good Schedule II fish habitat has been given a "C" designation. Except where otherwise demonstrated, a rule of thumb used for this exercise has been to limit good Schedule II habitat to stream reaches below the 1,067 metre contour. There are exceptions however such as streams in wide valleys with a meandering nature. These exceptions have also received a "C" classification. Streams flowing from lakes above 1,067 metre elevation that do not appear to have a steep grade are given a "C" designation.

"D" designations have been given to those streams for which little or no utilization is expected. These types of habitats would include areas where: stream grades are too steep; streams frequently dry up for various reasons; streams at elevations above 1,067 metres; streams which lack potential for food production; and some streams which have been badly degraded or which carry an unacceptable sediment load or which have unsuitable water quality.

In summary therefore, the resultant stream reach classification is as follows:-

1) "A" designation - Schedule I spawning area

2) "B" designation - Schedule I rearing area

3) "C" designation - Good schedule II habitat

4) "D" designation - Other Schedule II habitat (or total absence of habitat)

5) "X" designation - Previously designated placer mining area

This discussion has avoided discussing details such as the actual levels of sedimentation which are considered acceptable above natural background levels. More details on this are available in another discussion paper on the sediment rationale which has also been prepared in support of the Yukon Placer Guidelines.

If anyone wishes further information regarding stream classification or regarding the life history of the various fish species, Fisheries and Oceans personnel will be pleased to assist in any way possible.

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